PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A Device for Supplying a Submarine Vessel with Electrical Energy and Breathable Air

I, DIMITRI ISSAIEWITCH REBIKOFF, a French citizen, of 35 Boulevard, Cazagnaire, Cannes, France, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In very many cases of utilisation of submarine vessels, and especially of non-military uses for sport, photography, and under-water exploration at limited depth, there is no necessity for complete autonomy of the vessel, either as regards its propulsion or for the breathing of the divers who control it.

Autonomy necessitates the use of accumulator batteries, the maintenance of which is difficult and expensive for many applications.

For self-contained breathing, the diver has to employ cylinders of air at a pressure of 200 kgs. per sq. cm., which require the use, for re-filling, of a motor compressor set which is costly for a high pressure of this order.

The prevent invention overcomes these drawbacks by eliminating the accumulator battery and the air storage means for breathing in the submarine vessel itself, and replaces them by devices which are less costly, at least from the point of view of maintenance.

The invention consists in supplying the submarine vessel with breathable air and electrical energy through a composite cable comprising a pipe for the passage of the air, and insulated conductors for effecting at least one way communication to and from said vessel and for the supply of electric current serving to propel the vessel and to operate the various auxiliary apparatus and tools which it carries. This cable is coupled to a body floating on the surface of the water, which body has means for producing electric current and compressed air or is coupled to these means. By coupling the submarine vessel to the said means, it ensures its air-supply and its propulsion within the radius of action around the said floating body permitted by the length of the said electrical and compressed-air conduits.

The floating body may be stationary and may itself be supplied from a station which supplies to it at least the electric current and may carry the compression means supplying air to the submarine vehicle, or alternatively it may receive both supplies of compressed air and electrically derived from at least one independent fixed installation, floating or on land.

The floating body may, on the other hand, be a boat movable on the surface without connection with any stationary installation. This boat, which will have a crew, may be moved by towing by the submarine vessel, or it may be capable of independent motion to accompany the said vessel, this boat carrying means for production of electric current for the propulsion of the submarine vessel and means for compressing air for breathing for the crew of the submarine vessel.

In order to explain the invention more clearly, two forms of embodiment are described and shown in a very diagrammatic manner in the accompanying drawings.

These forms of embodiment are given by way of examples only and not in any sense by way of limitation.

In the embodiment shown schematically in Fig. 1, the floating body, coupled to the submarine vessel according to the invention by the assembly of electric conduits associated with the pipe for breathing air, is an accompanying boat, equipped with an internal combustion engine which can ensure simultaneously the propulsion of the said boat, the drive of a current generator for the electric propulsion of the submarine vessel and the drive of a high-pressure compressor to supply breathing air to the said vessel.

The submarine vessel 1 which will be, for example, of the type described by the present Applicant in French Patent No. 1,136,673 of the 7th December 1955, is coupled to the

escorting boat 2 by a tube 3 fixed behind the rudders and the screw of the submarine vessel 1, in such manner as not to interfere with them, and terminating at the relief valve of the pilot's breathing mask, the said pipe 3 passing with a water-tight seal into the boat 2, where it is coupled to an air compressor 4 which is driven in rotation, at the same time for example as the generator 5, by the internal combustion engine 6 which can drive the screw 8, by means of a clutch 7, at the same time as the compressor 4 and the generator 5 .

The generator 5 is connected to the submarine vessel 1 by insulated electric conductors passing through the hull of the boat and indicated diagrammatically at 9.

Between the boat 2 and the submarine vessel, the tube 3 and the insulated electric conductors 9 are assembled together in parallel so as to form a single composite cable 11.

This composite cable 11 is fixed to the boat 2 towards its front end and when current is supplied to the submarine vessel 1, the latter will move forward, towing the boat 2 which follows behind.

The towing effort will be reduced by engaging the clutch 7 coupling the screw 8 to the engine, the pilot of the boat adjusting his movement so as to follow the submarine vessel.

The composite cable 11 may advantageously comprise a core, twisted or not, to serve for towing purposes only, thus relieving the other parts of these stresses.

In the same way, the cable may comprise a telephone wire for speech communication between the pilots of the submarine vessel 1 and the escort boat 2. In the case in which the submarine vessel comprises external inflatable ballast-tanks 12 to regulate its buoyancy and its total submersion, means for controlling these tanks by the crew of the boat 2 may also be included in the complex cable II.

These control means may be a conduit system for inflating the ballast tank 12 by a high-pressure air cylinder carried in the boat 2 and operated by the crew of this boat, or an electric coupling for controlling inflation means carried by the submarine vessel and also operated by its pilot.

By this means, in case of failure of the pilot to act, due to some other emergency, the boat 2 could compel the submarine vessel to surface, which would be a considerable safety device for the pilot in particular.

As the submarine vessel can be relieved of the weight of the accumulators and of at least a large part of the breathing air cylinders, it may be fitted with equipment which it could not otherwise have received, for example photographic, television or lighting devices with their connections passing in the composite cable.

The autonomy of the unit is greatly increased since it eliminates the necessity for a boat for towing purposes which has previously existed in all cases of exploration at a distance from the coast located more or less out at sea.

The replacement of the accumulators by a generator on board the boat, which may be a dynamo or an alternator, and the replacement of a 200 kg. per sq. cm. compressor for charging the cylinders by a compressor supplying air at less than 10 kg. per sq. cm. for example, provide economical conditions of use and maintenance.

In Fig. 2 there is shown diagrammatically a form of embodiment of the invention which permits, in particular, the establishment of a nautical training school for training pilots of submarine vessels of small size. When installed close to a popular beach, in a fairly deep portion of a sea with little or no tide, for example, this engagement can, by hiring out the submarine vessel for fixed times, constitute a very popular and remunerative attraction for its promoters.

In this arrangement, the submarine vessel 1 is coupled by the composite cable 11 similar to that previously described, not to a movable boat but to a buoy 22 kept in position by known anchoring means, in this case shown diagrammatically by a single anchor 23 and its chain 24.

This buoy 22 is actually retained by at least two moorings in order to prevent it from turning on itself, thus causing a twist of the chain 24 with a composite cable 31 similar to the composite cable 11 of Fig. 1, which passes at 32 into the base of the buoy 22, to which it is fixed with a water-tight seal.

This composite cable 31 terminates at its other extremity in a platform 33, for example, on the short, on which are installed a source of electric current 34 and a compressor 35, together with the other members of the transmissions to be effected through the cables 31 and 11.

The source of electric power 34 may be of any kind: electric generating set, a transformer coupled to the supply system, or even a simple switchboard coupled to the supply system. It will be connected to the composite cable by conductors 36 and 37.

The compressor 35 will be driven by any kind of motor and will be coupled to the composite cable 31 by a pipe 38.

The composite cable 31 will lie on the bottom 30 of the water or will be buried in the ground between the platform 33 and the point immediately below the buoy 22.

In order to give the submarine vessel 1 complete freedom to turn round the buoy 22, the coupling of the composite cable 11 to the latter is effected through the extremity 39 of a hollow arm 41 which can rotate about the

vertical axis 40 of a hollow support 42 mounted on the buoy 22.

This hollow support 42 has passing through it a hollow shaft 43 rigidly fixed to the arm 41.

Fixing means and water-tightness means (not shown) are interposed between these various shafts and supports in order that, as the arm 41 is free to rotate, the ingress of spray into the buoy is prevented by rotating joints, baffles or other like means.

In the interior of the buoy, the extremity of the hollow shaft 43 is coupled through a rotary joint 44 to the extremity of the compressed-air tube 38.

The other extremity of the shaft 43 is coupled to the outlet of the air tube of the composite cable 11, and by this means, air from the compressor 35 is supplied to the submarine vessel 1 through the cables 31 and 11.

The hollow shaft 43 is also provided with conducting insulated rings 45 and 46, respectively coupled to the conductors of the composite cable 11 through the arm 41. Brushes 47 and 48, respectively connected to the conductors 36 and 37 of the composite cable 31 lead the current through these rings to the motor of the submarine vessel 1 through the composite cable 11, without interfering with the rotational movement of the arm 41.

Other rotary joints, both electric and pneumatic, could provide the secondary circuits necessary for other controls between the shore and the vessel, without going beyond the scope of the invention.

In the same way, instead of a fixed platform 33 for carrying the supply sources and the operating controls of the submarine vessel, there may be employed a boat or pontoon of any kind moored to the shore, or distant from the short and from the buoy, the cable 31 being on the bottom 30 and the distance between this fixed boat and the buoy permitting all the evolutions possible within the length of the composite cable 11.

Without going beyond the scope of the invention, and in order to have only electric connections between the fixed control platform and the buoy, it is even possible to house the motor compressor set inside the buoy 22, this set being controlled and supplied by electric means. The coupling between the buoy and the submarine vessel through the composite cable conveying electricity and air is still of course retained between these two latter, according to the characteristic feature of the invention.

The present invention is applicable to any type of submarine vessel working in the water or on the bottom, whether it is able to float or not, having a pilot on board or controlled from a distance, and occupied by one or more persons who are not piloting it, such as observers.

WHAT I CLAIM IS:—

1. A device for supplying a submarine vessel with electrical energy and breathable air, said device comprising a composite cable incorporating a pipe for the air supply and insulated conductors for effecting at least one way communication to and from said vessel and for supplying electrical energy serving for the propulsion of said vessel and for the operation of the various auxiliary apparatus and tools carried by said vessel, a body floating on the surface of the water, means housed in said body for producing electric current and compressed air, thereby ensuring the supply of air and propulsion energy to said vessel within the radius of activity around said floating body permitted by the length of said composite cable.

2. A device as claimed in claim 1, in which said floating body is a boat provided with a prime mover adapted to drive an air compressor and an electric generator, and further comprising means for coupling the output from said compressor and said generator to said composite cable.

3. A device as claimed in claim 2, and further comprising clutch means housed in said boat for driving the propeller of said boat at will from said prime mover.

4. A device for supplying a submarine vessel with electrical energy and breathable air, said device comprising a composite cable incorporating a pipe for the air supply and insulated conductors for supplying electrical energy serving to propel the vessel and to operate the various auxiliary apparatus and tools carried by said vessel and conductors for effecting signalling communication to and from said vessel, a buoy floating on the surface of the water and anchored on the bottom, means for coupling said composite cable to said buoy, said means comprising rotary watertight joints rotatable about a vertical axis, thereby permitting operation of said submarine vessel all round said buoy and means for supplying to said composite cable within said buoy the said electrical energy and breathable air.

5. A device as claimed in claim 4, in which the electric supply and compressed-air supply means are installed on shore, the shore installation being coupled to said buoy through a further composite cable comprising an air tube and insulated electric conductors, and means provided in the interior of said buoy for coupling said second composite cable to the first composite cable coupled between said buoy and said submarine vessel.

6. A device as claimed in claim 4, and further comprising means housed in said buoy for providing compressed air, means for remotely controlling said compressed-air supply means electrically from an independent station incorporating electric power supply means, and electric cable means coupling said

station to said buoy.

7. A device as claimed in claim 1, in which said submarine vessel is provided with inflatable ballast tanks for controlling its buoyancy, and further comprising means operated from the floating body supplying said vessel with air and power, for inflating said ballast tanks independently of the action of the pilot of said submarine vessel.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

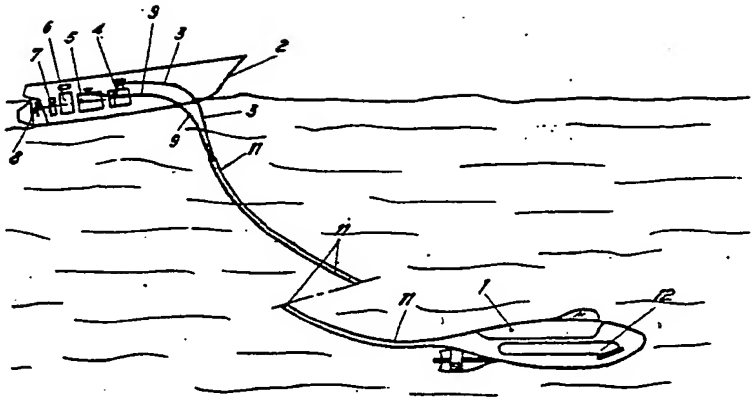

Fig.1

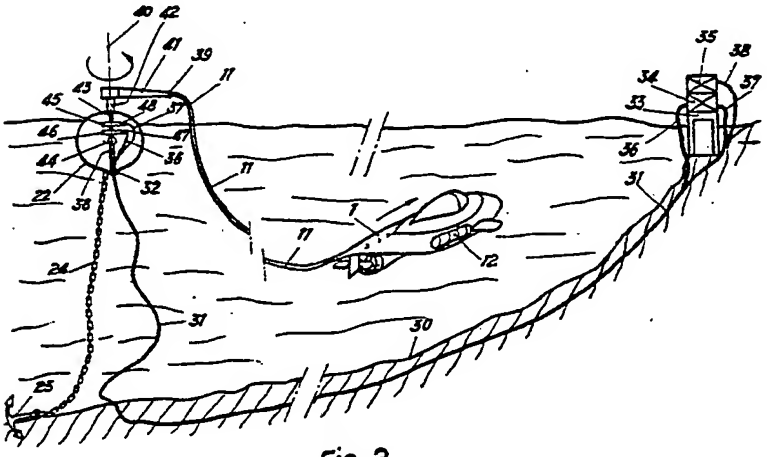

Fig.2